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important localities, and by ignoring the numerous observations that have been published during the last 30 years on the natural history of our native plants.

Considering the large size of some of the volumes published by the Smithsonian Institution, entitled Contributions from the U. S. National Herbarium, it seems more than strange that said Institution, now for 8 years, has withheld Dr. Edw. L. Greene's second volume of Botanical Landmarks. Dr. Greene's painstaking work deserved a better fate; for when considered in comparison with the works discussed in the preceding pages one can scarcely doubt that Dr. Greene's history is better fitted to fulfill the function for which the Smithsonian Institution avowedly exists, i. e. "For the diffusion of knowledge among men."

In bringing this discussion to a close, I cannot abstain from expressing the opinion about the new Flora of the District of Columbia, that its aim was not to distribute knowledge among men; but rather to enforce the Brittonian nomenclature, to apotheosize the National Herbarium, and to distribute among men, in the guise of scientific authority, an unprecedented ignorance of elementary Botany.

Clinton, Md., June 1921.

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### **Notes on the Habits of the Soft-Shell Turtle—*Amyda Mutica*.**

BY J. F. MULLER, J. H. U.

The observations forming the basis of this article were made on an island of the Mississippi River, about a mile above Fairport, Iowa, and on the Illinois side, while the writer was serving in the Bureau of Fisheries. This island was very typical of the large number scattered along the river. Approximately triangular in shape, it was bounded on the north by the open river, on the south by a narrow channel, or slough, between it and another island, on the east by another channel and island, and on the west by an area of shallow

water dropping away toward the north into the navigable part of the river. With gently sloping sand and mud shores, and interior areas of open sand and densely growing willows, it offered a variety of natural conditions. In area it was about a half mile square.

Of the two soft shell-turtles common in the vicinity, *Amyda mutica*, and *spinifera*, only the former was carefully observed. This species grows to an approximate length of fourteen inches, carapace measurement, and is highly esteemed as an article of food, being said to taste better than chicken.

During the breeding season, June and July, the turtles frequently leave the water to bask, usually in the morning up until 2:00 P. M., and their tracks being very conspicuous, a count of them gives accurate estimate of their numbers. Observation of these indicated that the turtles prefer beaches with a northern exposure, probably because of the greater amount of sunlight there in summer. The warmer the day, the greater was the number of tracks. On July the second, apparently thirty-seven turtles had congregated within fifty feet of beach on the north side of the island while only three tracks could be found on the entire south side. The turtles emerge from the water in an almost straight line until from four to ten feet up the beach, where they remain awhile in the sun, turning around several times before returning to the water, the return track often overlapping the first. When alarmed, the animals slip down the beach and into the water with great rapidity. On several occasions large females were disturbed while laying their eggs, about fifty feet from water, and covered the distance faster than a man can run. They are not at all awkward in their land movements as might be inferred from their appearance.

In this locality the egg laying season covers the last half of June and the early part of July. In building her nest, the female selects a spot with an unobstructed view of the open water, and from ten to sixty feet inland. Here she scoops out a hole in the sand, about five inches in diameter, and ten inches deep, using her fore paws in the operation, and piling up the loose sand around the hole. The necessary conditions for incubation are sufficient dampness so that the sand will just cling together, and absence of clayey or earthy matter

which might cause the sand to pack and thus prevent the escape of the young. Often in her search of proper conditions the female will dig three or four holes before laying her eggs. A suitable nest being dug the turtle assumes a position with her hind feet down the hole, and dropping her eggs into her hind paws, arranges them neatly upon the floor of the nest. The hole is then filled in with the sand removed from it, the hind feet being used.

The number of eggs laid varies with the size of the turtle. Eight nests contained respectively 12, 13, 4, 22, 21, 16, 26, 33 eggs. The last nest probably contained an abnormally large number, as in it two double eggs were found, one being oval-cylindrical and having two yolks, with no dividing partition, and the other having a sharp constriction and median partition. From this it is evident that the oviducts were crammed beyond their normal capacity. The average annual lay of a female would be around twenty-two. The finished nest appears as a small crater on the sand, about a foot in diameter, or, where the surface is covered with pebbles, as a circular area of clear sand. The temperature of the nests is quite constant—about 90°F. In abandoning unsuitable nests, the female leaves the holes open, to be filled in at the next rain.

Many nests were found the eggs of which had been dug up and eaten as evidenced by the empty shells around. As ground moles were numerous on the island, it is probable that these were responsible. However, coon tracks are sometimes to be found at such ruined nests, and crows are said to dig up the eggs also. The destruction of the species in this way must be considerable, for at least forty such ruined nests were found on the one small island in consideration. Occasionally eggs are found which have been parasited by maggots, presumably of some sort of fly. It is doubtful, however, whether eggs containing healthy embryos are ever attacked in this way, as out of a nest of twenty eggs two may be found to contain maggots, and be in a state of decomposition, while the rest are perfectly sound. An egg of this turtle is about 2.3 cm. in diameter, and weighs about 7 grs.

At first pale yellow, the egg after about eight days development becomes white on the top half, and the yolk rises and

adheres to this pole. The albumen is at first very gelatinous, but later becomes quite mobile.

For studying incubation several artificial nests were prepared in small sandpiles placed in the angle of the floor and wall of an empty cement pond bed. Some eggs were collected when the embryos had attained about three weeks development, and others when recently laid, care being taken to preserve the original position. Advanced eggs were placed so that the white pole would be on top. A week later, however, these eggs showed a new white pole, at an angle to, and lapping over the first. This new pole was tilted toward the south. As the nests were placed against the vertical northern wall of the pond, it is obvious that the south was the direction of most light and heat. Apparently, then, this white pole forms with relation to direction of heat, rather than gravity. In about a month this white area has descended and completely covered the egg, keeping pace with the growing allantois. Before incubation has proceeded far the air chamber appears on the bottom of the egg. Excessive moisture causes the eggs to rot, whereas too little usually merely retards development. As the embryo grows the calcareous part of the shell becomes very much cracked and the shell membrane, yielding to pressure from within, stretches until the egg becomes approximately 2.39 cm. in diameter. The carapace is folded down around the young turtle and the arms are extended in front of the head. The forepaws are thrust thru the shell first in hatching, and this opening enlarged to allow egress for the rest of the body. Altho the young have an egg-tooth below the flexible proboscis it does not seem to be used in escape from the eggs, and is dropped a week after hatching.

The young, which are very circular, have the dull olive carapace marked with many short black lines, and bordered with a margin of pale flesh color, broader to the rear. The feet are well webbed and immaculate below. The following are measurements of five newly hatched *A. mutica*.

CARAPACE		PLASTRON
Length	Width	Length
3.5 cm.	3.1 cm.	2.5 cm.
3.5 cm.	3.23 cm.	2.55 cm.
3.43 cm.	3.20 cm.	2.60 cm.
3.67 cm.	3.25 cm.	2.57 cm.
3.62 cm.	3.2 cm.	2.47 cm.

Weight of an average specimen: 4.97 grs.

The eggs in the artificial nests hatched on July 29, 30, 31. Observation on the island showed that the nests hatched there from July 31 up thru the early part of August. In escaping from the nest the young turtle leaves the egg shell below the surface and tunnels almost vertically upward, leaving a hole in the sand about an inch in diameter to mark the spot of escape. On spots where nests have hatched a number of these holes may be seen on the surface within several inches of each other. No newly hatched turtles were found on the island. They always hatched during the night or early morning, and probably lost no time in getting to the water. Under favorable conditions the period of incubation is from seventy to seventy-five days, depending upon circumstances of heat and moisture.

The young exhibit a marked geotropism, always going downhill, and are photokinetic upon any disturbance. Since the nests are usually so situated that an open sky and sloping beach are presented in the direction of the water it is probable that these two factors guide the young to the river. They are perfect swimmers immediately after hatching and if held and irritated they make repeated efforts to bite. Placed in a sand bottomed aquarium they dig under at once, coming out again only after the suspected danger has passed. They seize edible morsels eagerly after a thorough probing with their flexible noses. At least six or seven years are required before they attain edible size.